

TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

TC7S04F, TC7S04FU

INVERTER

The TC7S04 is a high speed C²MOS INVERTER fabricated with silicon gate C²MOS technology.

It achieves high speed operation similar to equivalent LSTTL while maintaining the C²MOS low power dissipation.

The internal circuit is composed of 3 stages including buffer output, which enables high noise immunity and stable output.

The input is equipped with protection circuits against static discharge or transient excess voltage.

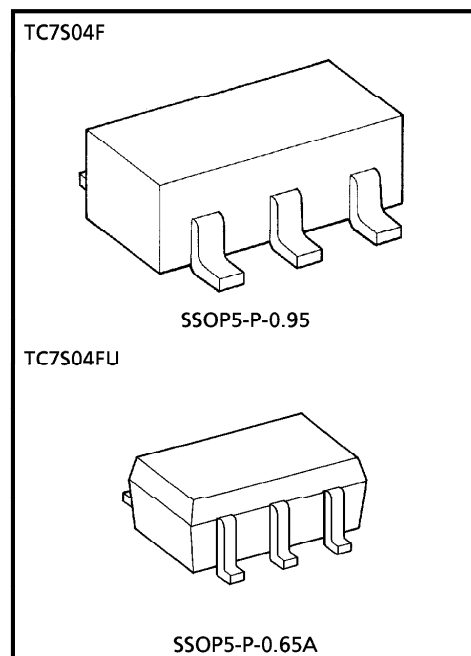
Output currents are 1/2 compared to TC74HC series models.

FEATURES

- High Speed $t_{pd} = 7\text{ns}$ (Typ.) at $V_{CC} = 5\text{V}$
- Low Power Dissipation $I_{CC} = 1\mu\text{A}$ (Max.) at $T_a = 25^\circ\text{C}$
- High Noise Immunity $V_{NIH} = V_{NIL} = 28\% V_{CC}$ (Min.)
- Output Drive Capability 5 LSTTL Loads
- Symmetrical Output Impedance ... $|I_{OH}| = I_{OL} = 2\text{mA}$ (Min.)
- Balanced Propagation Delays $t_{pLH} \approx t_{pHL}$
- Wide Operating Voltage Range ... $V_{CC}(\text{opr}) = 2 \sim 6\text{V}$

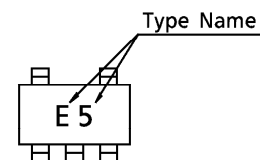
MAXIMUM RATINGS

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage Range	V_{CC}	$-0.5 \sim 7$	V
DC Input Voltage	V_{IN}	$-0.5 \sim V_{CC} + 0.5$	V
DC Output Voltage	V_{OUT}	$-0.5 \sim V_{CC} + 0.5$	V
Input Diode Current	I_{IK}	± 20	mA
Output Diode Current	I_{OK}	± 20	mA
DC Output Current	I_{OUT}	± 12.5	mA
DC V_{CC} / Ground Current	I_{CC}	± 25	mA
Power Dissipation	P_D	200	mW
Storage Temperature	T_{stg}	$-65 \sim 150$	$^\circ\text{C}$
Lead Temperature (10s)	T_L	260	$^\circ\text{C}$

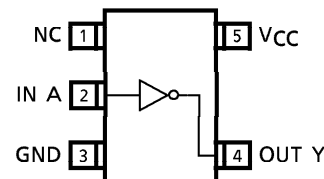


Weight SSOP5-P-0.95 : 0.016g (Typ.)
SSOP5-P-0.65A : 0.006g (Typ.)

MARKING



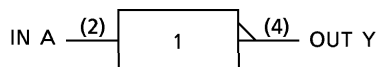
PIN ASSIGNMENT (TOP VIEW)



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● TOSHIBA is continually working to improve the quality and the reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to observe standards of safety, and to avoid situations in which a malfunction or failure of a TOSHIBA product could cause loss of human life, bodily injury or damage to property. In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent products specifications. Also, please keep in mind the precautions and conditions set forth in the TOSHIBA Semiconductor Reliability Handbook.

CIRCUIT DIAGRAM



RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	V_{CC}	2~6	V
Input Voltage	V_{IN}	0~ V_{CC}	V
Output Voltage	V_{OUT}	0~ V_{CC}	V
Operating Temperature	T_{opr}	-40~85	°C
Input Rise and Fall Time	t_r, t_f	0~1000 ($V_{CC} = 2.0V$) 0~500 ($V_{CC} = 4.5V$) 0~400 ($V_{CC} = 6.0V$)	ns

DC ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	SYMBOL	TEST CONDITION	$T_a = 25^\circ\text{C}$				$T_a = -40 \sim 85^\circ\text{C}$		UNIT
			V_{CC}	MIN.	TYP.	MAX.	MIN.	MAX.	
High-Level Input Voltage	V_{IH}	—	2.0 4.5 6.0	1.5 3.15 4.2	— — —	— — —	1.5 3.15 4.2	— — —	V
Low-Level Input Voltage	V_{IL}	—	2.0 4.5 6.0	— — —	— — —	0.5 1.35 1.8	— — —	0.5 1.35 1.8	V
High-Level Output Voltage	V_{OH}	$V_{IN} = V_{IL}$ $I_{OH} = -20\mu\text{A}$	2.0 4.5 6.0	1.9 4.4 5.9	2.0 4.5 6.0	— — —	1.9 4.4 5.9	— — —	V
			4.5 6.0	4.18 5.68	4.31 5.80	— —	4.13 5.63	— —	
			—	—	—	—	—	—	
Low-Level Output Voltage	V_{OL}	$V_{IN} = V_{IH}$ $I_{OL} = 20\mu\text{A}$	2.0 4.5 6.0	— — —	0.0 0.0 0.0	0.1 0.1 0.1	— — —	0.1 0.1 0.1	V
			4.5 6.0	— —	0.17 0.18	0.26 0.26	— —	0.33 0.33	
			—	—	—	—	—	—	
Input Leakage Current	I_{IN}	$V_{IN} = V_{CC}$ or GND	6.0	—	—	± 0.1	—	± 1.0	μA
Quiescent Supply Current	I_{CC}	$V_{IN} = V_{CC}$ or GND	6.0	—	—	1.0	—	10.0	

Output currents are 1/2 compared to TC74HC series models.

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AC ELECTRICAL CHARACTERISTICS (C_L = 15pF, Input t_r = t_f = 6ns, V_{CC} = 5V)

CHARACTERISTIC	SYMBOL	TEST CONDITION	Ta = 25°C			UNIT
			MIN.	TYP.	MAX.	
Output Transition Time	t _{TLH} t _{THL}	—	—	5	10	ns
Propagation Delay Time	t _{pLH} t _{pHL}	—	—	7	15	ns

AC ELECTRICAL CHARACTERISTICS (C_L = 50pF, Input t_r = t_f = 6ns)

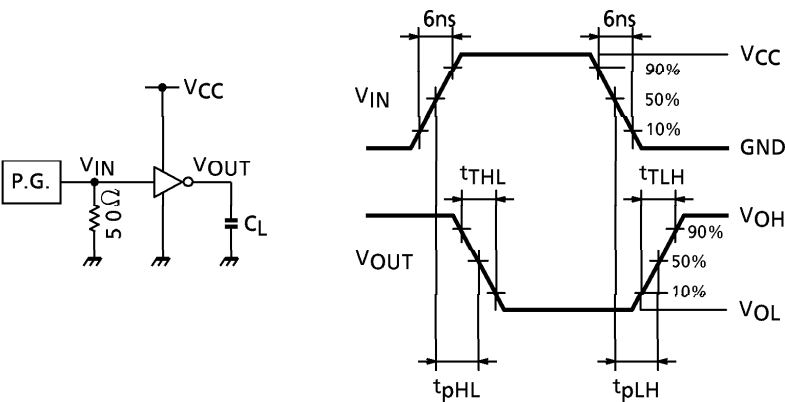
CHARACTERISTIC	SYMBOL	TEST CONDITION	Ta = 25°C			Ta = -40~85°C		UNIT
			V _{CC}	MIN.	TYP.	MAX.	MIN.	MAX.
Output Transition Time	t _{TLH} t _{THL}	—	2.0	—	50	125	—	155
			4.5	—	14	25	—	31
			6.0	—	12	21	—	26
Propagation Delay Time	t _{pLH} t _{pHL}	—	2.0	—	48	100	—	125
			4.5	—	12	20	—	25
			6.0	—	9	17	—	21
Input Capacitance	C _{IN}	—	—	5	10	—	10	pF
Power Dissipation Capacitance	C _{PD}	(Note 1)	—	10	—	—	—	

Note 1 : C_{PD} defined as the value of internal equivalent capacitance of IC which is calculated from the operating current consumption without load (refer to Test Circuit).

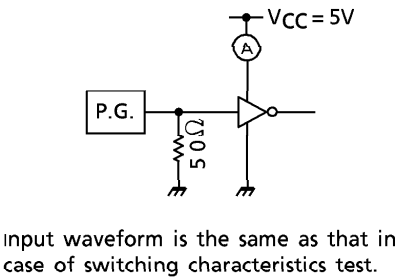
Average operating current can be obtained by the equation hereunder.

I_{CC (opr)} = C_{PD} · V_{CC} · f_{IN} + I_{CC}

SWITCHING CHARACTERISTICS TEST CIRCUIT

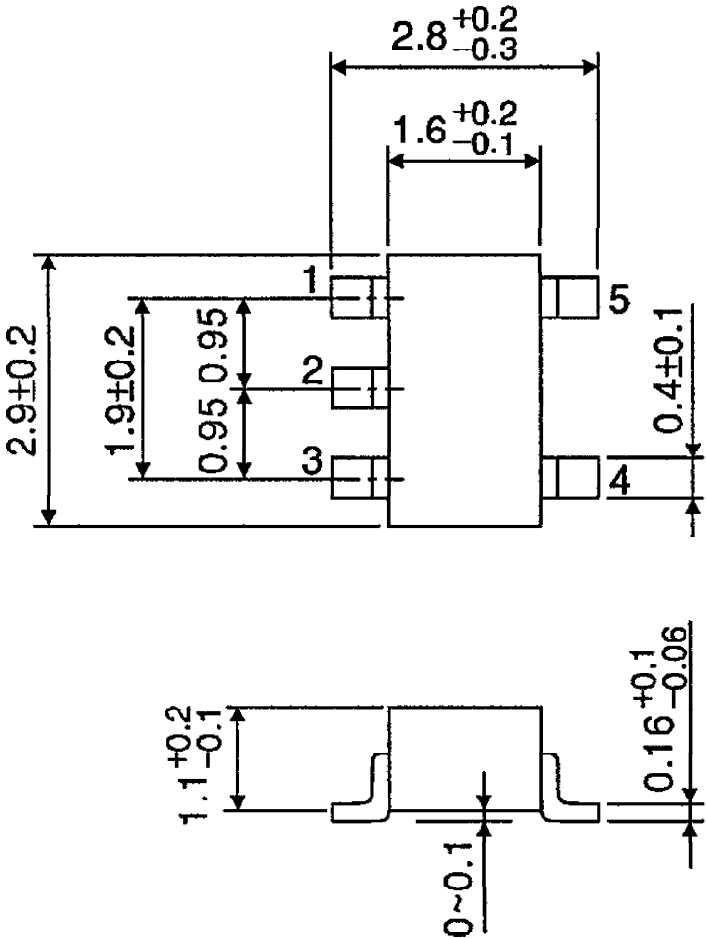


I_{CC (opr)} TEST CIRCUIT



OUTLINE DRAWING
SSOP5-P-0.95

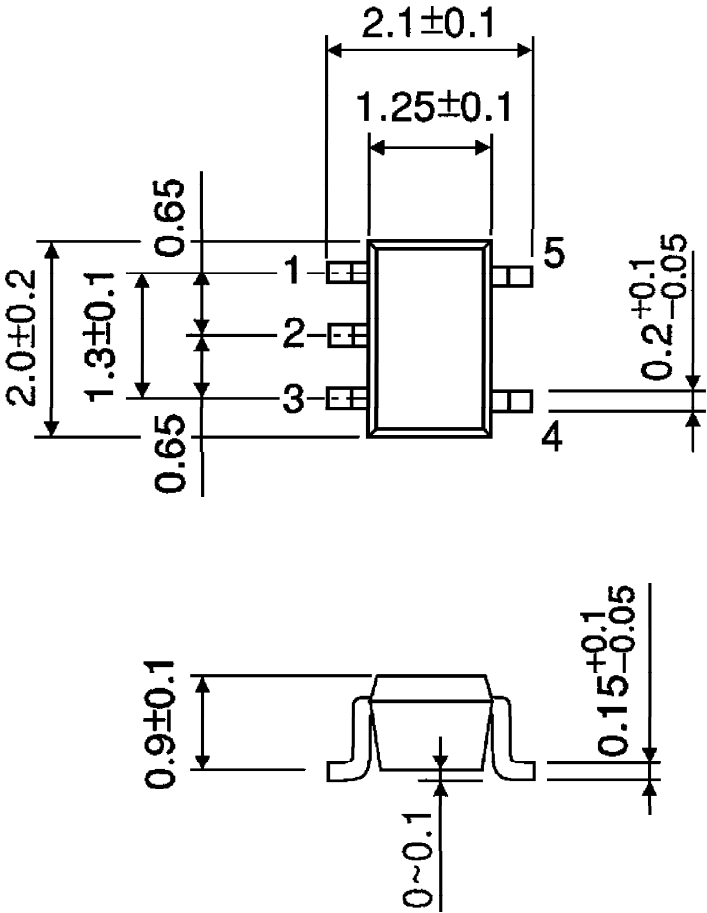
Unit : mm



Weight : 0.016g (Typ.)

OUTLINE DRAWING
SSOP5-P-0.65A

Unit : mm



Weight : 0.006g (Typ.)